PROFILE OF

OAK RIDGE NATIONAL LABORATORY

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Office of Oversight
Environment, Safety and Health
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FOREWORD

Site profiles provide senior Office of Environment, Safety and Health managers with relevant and current site environment, safety, and health performance information as well as communicating to Department of Energy line management the Office of Oversight's concerns and understanding of site conditions. Site profiles are a key management tool used by the Office of Oversight to focus and prioritize independent oversight evaluation activities and to optimize the allocation of Oversight resources. The Office of Oversight maintains site profiles on 20 major Department of Energy sites, and normally updates each profile semiannually through a process of soliciting Department of Energy line management review and comment on the revised site profile information. Upon resolution of any line management comments, the profile is considered validated and is disseminated.

Site profiles are developed using an institutionalized process of collecting data from multiple sources, and then collating, synthesizing, and analyzing this information to develop a balanced evaluation of environment, safety, and health performance at the site. The data that forms the basis of a site profile comes from sources both internal and external to the Department of Energy. Office of Oversight appraisal activities provide an important source of data. Data is also collected and synthesized from such sources as the Defense Nuclear Facilities Safety Board, the General Accounting Office, state regulators, and Department of Energy line management organizations. This information is reported in a format designed to highlight essential missions, performance, significant issues, and operational data at a management level. The process involves additional field verification of initial conclusions to confirm the validity and significance of the information. All Oversight offices participate in the collection, analysis, interpretation, and validation of site profile information.

As the site profile process matures, the Office of Oversight plans to incorporate additional information into the documents, including a presentation of quantitative measures and trends in environmental, safety, and health performance, and a description of safeguards and security activities, performance, and issues.

PROFILE OF

OAK RIDGE NATIONAL LABORATORY (ORNL), (X-10)

OVERVIEW

SITE CHARACTERISTICS

Site characteristics include information on site size and location, mission, organizations, contractual status, and major initiatives and activities.

Additional information on site characteristics is provided in Section 1.0, starting on page 1.

Date Established: 1942

Present Mission:

Primary - Conduct basic and applied research and development (R&D) to advance the nations energy resources, environmental quality, scientific knowledge, educational foundations, and industrial competitiveness.

ORNL conducts basic and applied research and development activities.

Secondary - Manufacturing technologies, computational science, and advanced computing.

Size: 24,832 acres situated on the Oak Ridge Reservation.

Employees: There were 6,399 site employees at the ORNL site as of March 22, 1996. This includes 4,399 Lockheed Martin Energy Systems (LMES) employees, and 45 Department of Energy (DOE) employees assigned to the ORNL Site Office by the Oak Ridge Operations Office (ORO)

Annual Budget: $544 million for fiscal year 1995.

Cognizant Secretarial Officer: Assistant Secretary for Energy Research (ER) for operational facilities. The Assistant Secretary for Environmental Management (EM) is responsible for a large and increasing number of shut down facilities. The principal offices within ER are ER-10, ER-20, ER-30, and ER-70. Within EM the principal offices are EM-30, EM-40, and EM-60. The Assistant Secretaries for Defense Programs (DP) and Nuclear Energy (NE) also have interests.

Responsible Operations/Area Office: DOE Oak Ridge Operations Office (ORO).

Management and Operations Contractor: Lockheed Martin Energy Research Corporation.

Subcontractor: MK Ferguson-Oak Ridge Company (MKFO)

DOE Subcontractor: Johnson Controls Incorporated (JCI).

Fissile Material: 41kg of Pu-239 waste (as of February 6,1996); substantial amounts of U-233 and U-235; and limited amounts of Pu-239.

Significant Commitments to Stakeholders: Programmatic Agreement (PA) concerning management of historic and cultural properties at Oak Ridge Reservation - a three party agreement among OR, the Tennessee State Historic Preservation Officer, and the National Advisory Council on Historic Preservation. The Land Disposal Restriction Federal Facilities Compliance Agreement (FFCA) requires DOE to cleanup several legacy sites. The Tennessee Oversight Agreement between DOE and the Tennessee Department of Environment and Conservation (TDEC) is currently being renegotiated. This agreement establishes a mechanism to provide ORNL environmental protection information to the Tennessee Department of Environment and Conservation.

Agreements associated with the management of historic and cultural properties influence site activities.

Unions: Atomic Trades and Labor Council (ATLC). This contract expires June 1996.

Major Site Activities:

Spent fuel is stored at the Molten Salt Reactor Experiment, High Flux Isotope Reactor, the Tower Shielding Reactor, and the Bulk Shielding Reactor .

Waste management activities are conducted at several waste treatment, storage, and disposal facilities. Collection and solidification of the liquid waste into a cement-based formula is performed at the liquid low-level waste solidification project. Solid radioactive and hazardous wastes are also collected, processed, stored, disposed of, or buried on site. A number of closed and operating solid waste storage areas are located at ORNL.

The Molten Salt Reactor Experiment is a decontamination and decommissioning project. Significant issues have arisen at the experiment associated with criticality control and radiation levels in the reactor fuel tanks in the lower levels of the facility.

Extensive construction efforts are ongoing.

No privatization activities are planned at ORNL.

ENVIRONMENT, SAFETY AND HEALTH (ES&H) ISSUES

A sitewide issue is an issue present at multiple facilities or within ES&H programs that impact sitewide operations. A facility-specific issue is limited to a particular facility or building.

Additional information on sitewide issues is provided in Section 3.0, starting on page 6.

Sitewide Issue 1: Management of ORNL by the Oak Ridge Operations Office is fragmented.

There are two sitewide and one facility-specific issue at ORNL

Sitewide Issue 2: The Molten Salt Reactor Experiment (MSRE) poses potentially serious risk to workers and the environment.

Facility-Specific Issue 1: The safety of MSRE operations is degraded by; questionable adequacy of the safety basis documentation, insufficient DOE oversight, deficient configuration management and conduct of operations, and the level of review for readiness for reactive gas removal startup.

KEY FACILITIES

A key facility is a facility or building that is significant from an environment, safety, and health perspective. At some sites, a key facility can be a group of facilities with similar missions, activities, hazards, or vulnerabilities.

Additional information on key facilities is provided in Section 4.0, starting on page 8.

Building 2026, High Radiation Materials Analytical Laboratory - Contains small quantities of fissile materials and larger quantities of radioactive materials. Activities are primarily analytical chemistry.

There are 13 key facilities at ORNL.

Building 3010, Bulk Shielding Reactor - This facility is used to conduct shielding studies and has been inactive for several years.

Building 3019A, Radiochemical Development Facility - The major activity within the facility is the safeguarded storage of multikilogram quantities of concentrated fissile nuclides.

Building 3025E, Irradiated Materials Examination and Testing Facility - Supports post irradiation testing within the Metals and Ceramic Division.

Building 3027, Special Nuclear Materials Vault - Storage of special nuclear materials.

Building 3038, Isotope Development Laboratory - Temporary storage of radioactive material.

Building 3517, Fission Product Development Laboratory - Separation of kilocurie amounts of fission products operations shutdown in 1989. Stores fission products pending deactivation in 1999.

Building 3525, Irradiated Fuel Examination Laboratory - Used for receipt, handling, and testing of irradiated materials.

Building 7503, Molten Salt Reactor Experiment - Investigates the practicality of the molten salt reactor concept.

Building 7700, Tower Shield Reactor - A nuclear facility in standby status awaiting funding to remove the reactor fuel and start decontamination and decommissioning.

Building 7900, High Flux Isotope Reactor - A reactor operated for research and the production of radioisotopes for medical and industrial purposes.

Building 7920, Radiochemical Engineering Development - Recovery and purification of transuranic elements from irradiated targets.

Liquid Low-level Waste System - Processes large quantities of liquid waste containing hazardous and low-level radioactive by-products.

SITE PERFORMANCE

Site performance is based on an analysis of available data on facilities and programs. This includes information from Office of Oversight activities, augmented by valid and relevant external and internal sources. Site performance is evaluated in terms of three of the guiding principles for safety management.

Additional information on site performance is provided in Section 2.0, starting on page 4.

Overall Safety Management Program - NOT EVALUATED

Principle #1 - Line Management Responsibility - NOT EVALUATED

Not fully evaluated. Deficiencies were recorded in definition of authority and accountability for performance within the corrective actions program.

Principle #2 - Comprehensive Requirements - NOT EVALUATED

Not fully evaluated. EH Resident surveillances identified requirement deficiencies within the nuclear criticality program, lack of formality within the corrective actions program, and insufficient documentation to demonstrate compliance with conduct of operations requirements.

Principle #3 - Competence of Personnel - NOT EVALUATED

Not evaluated.

PERFORMANCE MEASURES

Performance measures are quantitative and qualitative indications of ES&H performance taken from such sources as the Occurrence Reporting and Processing System and the Computerized Accident/Incident Reporting System, as well as contractually mandated indicators of performance.

To be provided in future versions of the site profile.

Additional information on performance measures will be provided in Section 5.0 of future versions of the site profile.

Figure 1. ORNL Site Map

SITE PROFILE -- OAK RIDGE NATIONAL LABORATORY (ORNL), (X-10)

1.0 SITE CHARACTERISTICS

1.1 SITE LOCATION AND SIZE

ORNL is one of three DOE installations on the 34,545 acre DOE Oak Ridge Reservation in eastern Tennessee. ORNL's activities presently occupy 24,832 acres, of which 13,590 are designated as the National Environmental Research Park. ORNL activities use approximately 1,153 acres of developed land. ORNL also has responsibility for approximately 1,500 acres of land and a number of unused farm structures on the Freels Bend Peninsula and Solway Bend of Melton Hill Lake.

1.2 SITE MISSION

In 1942, operations commenced at the Oak Ridge facilities in support of the Manhattan Project. As a DOE multiprogram laboratory ORNL conducts basic and applied research and development to advance the nation's energy resources, environmental quality, scientific knowledge, educational foundations, and industrial competitiveness.

ORNL's four core competencies are:

- Energy production and end-use technologies.
- Advanced materials synthesis, characterization, and processing.
- Biological and environmental science and technology.
- Neutron-based science and technology.

Additionally, two emerging competencies have been identified:

- Manufacturing technologies (shared with the Oak Ridge Y-12 Plant).
- Computational science and advanced computing.

1.3 SITE ORGANIZATIONS AND CONTRACT STATUS

Organization of Oak Ridge Operations Office

The Oak Ridge Operations Office (ORO) is responsible for managing and overseeing operations of all facilities under its jurisdiction. The three largest sites are located in Oak Ridge, Tennessee: the Oak Ridge National Laboratory (ORNL), the Oak Ridge Y-12 Plant (Y-12) and the Oak Ridge K-25 Site (K-25). ORO continues to maintain a presence at Paducah and Portsmouth Gaseous Diffusion Plants primarily for environmental remediation and waste management.

ORO has delegated all day-to-day operational functions of ORNL, Y-12, and K-25 to the DOE site offices, headed by a site office manager and associated support staff. The staff at the site offices are considered a line function, and report through the Site Office Manager to the appropriate ORO Assistant Managers (Defense Programs, Energy Research, Environmental Management, and Uranium Enrichment Operations).

The ORO Manager is the contracting officer for all ORO projects. The site office managers are designated as "Contracting Officer's Representatives" for most of the projects at their sites, except those administered directly by ORO or another line function. For example, the DOE Y-12 Site Manager is responsible for all day-to-day production and operation related activities at Y-12, but is not responsible for environmental restoration and waste management activities, which are managed by the Assistant Manager for Environmental Management. The site office managers are not responsible for contracts managed by other elements of ORO, such as

the Oak Ridge Federal/Integrated Communications Network (ORF/ICN), which is managed by ORO's Information Resources Management Division.

ORO sites are operated by Lockheed Martin Energy Systems (LMES). LMES has created a structure similar to ORO and assigned day-to-day plant-level operations to each site's management chain. LMES has retained certain functions at its corporate office, such as administering large subcontractors who operate at more than one site. For example, the M. K. Ferguson-Oak Ridge Company managed by LMES, is the Construction Manager for all major ORO sites.

ORO also administers other contracts for the Oak Ridge Reservation, including the contract with Johnson Control, Inc. for management of the Oak Ridge Water Treatment Plant and maintenance of roads and grounds; U. S West for ORF/ICN; Bechtel National Corporation for environmental remediation and demonstration projects; and Jacobs Engineering and Lockwood Greene for architect/engineering services. OR has recently begun a contracting process whereby specialized services are let and managed by Lockheed Martin Energy Systems (LMES) or others. These projects are also considered outside the normal scope of the DOE site office's responsibilities.

Recent staff realignments within ORO have resulted in the matrixing of most support staff functions to the three OR sites. For example, most of the technical staff within the ORO Safety and Health Division have either been reassigned to one of the three ORO sites, or have been transferred to support organizations located within ORO's Environmental Protection Division. It is unclear at this time, how ORO will discharge responsibilities for conducting multifunctional appraisals, special reviews, and other processes, previously assigned to the Safety and Health Division.

ORNL Site Organization

Activities at ORNL are managed by the ORNL site office. There are 700 U.S. DOE employees assigned to ORO, 45 of whom are located at ORNL. On a typical day, ORNL accommodates nearly 2,000 additional people, including temporary and part-time employees, members of the contractor's central organization, DOE employees, and visitors.

The ORNL staff consists of a site manager, a deputy site manager and operations, program support, and programs branch managers The site manager reports to the ORO Assistant Manager for Energy Research and Development. ORNL does not have line management responsibility for the High Flux Isotope Reactor, several other shut down (but fueled) reactors, or the many other shut down nuclear facilities on ORNL.

The High Flux Isotope reactor, the Radiochemical Engineering Development Center, and the Isotope Enrichment Facility are managed by the Reactor Operations Division, who reports to the ORNL Energy Research and Development Assistant Manager. The shut down reactors and other nuclear facilities are managed by the Environmental Restoration Division Director, who reports to the Environmental Management Assistant Manager. Neither the Reactor Operations Division nor the Environmental Restoration Division report to the ORNL Site Manager.

Contract Status

ORNL is managed by Lockheed Martin Energy Research Corporation. The current contract expires on March 31, 1998.

1.4 MAJOR SITE INITIATIVES/ACTIVITIES

Spent Fuel Storage and Management

Spent fuel is stored at the Molten Salt Reactor Experiment, High Flux Isotope Reactor, the Tower Shielding Reactor, and the Bulk Shielding Reactor .

Waste Management

Waste management activities are conducted at several waste treatment, storage, and disposal facilities. These activities produce large quantities of toxic low-level radioactive byproducts. Collection and solidification of the liquid waste into a cement-based formula is performed using a mobile commercial radioactive waste solidification system at the liquid low-level waste solidification project. Solid radioactive and hazardous wastes are also collected, processed, stored, disposed of, or buried on site. A number of closed and operating solid waste storage areas are located at ORNL.

Decontamination and Decommissioning

The Molten Salt Reactor Experiment is a decontamination and decommissioning project. Significant issues have arisen at the experiment associated with criticality and radiation levels in the reactor fuel tanks in the lower levels of the facility. A number of other key facilities at ORNL are under the management of the environmental management assistant manager, even though decontamination and decommissioning of the facilities has not started.

Privatization Activities

No privatization activities are planned at ORNL.

Programmatic Activities

ORNL conducts basic and applied research and development to advance the nation's energy resources, environmental quality, scientific knowledge, educational foundations, and industrial competitiveness.

Construction Activities

Construction activities in excess of $1 million are the Melton Valley liquid low-level waste collection and transfer system ($41.0M); solid state research laboratory ($3.0); process waste treatment system upgrade ($6.0M); sanitary sewer system upgrade ($16.0M); replace deteriorating roofing ($16.0M); process waste surge tank ($10.0M); S&M well plug ($23.0M); D&D of Building 3506 ($2.0M); Waste Area Group 7 ISV demonstration ($6.0M); fire protection upgrade ($4.7M); Oak Ridge Federal Integrated Communications Network ($6.7M); and Bethel Valley low level waste systems upgrade($65.0M). (as of October 1995)

Other minor construction projects for fiscal year 1996 are the REDC cooling tower; an upgrade of the heating, ventilation, and cooling system; the waste minimization project, Building 2525; and the maintenance shop addition, Building 4509.

2.0 SITE PERFORMANCE

2.1 CONCEPTUAL BASIS FOR EVALUATION

The essential characteristic of successful programs and projects is the recognition and understanding of the need for an effective management system that ensures adequate control over all aspects of the program or project. In 1994, the Secretary of Energy forwarded to Congress and the Defense Nuclear Facilities Safety Board the principles and criteria that the Department deemed necessary for an effective safety management program. These principles include:

- Principle #1: Line managers are responsible and accountable for safety.
- Principle #2: Comprehensive requirements exist, are executed, and are appropriate.
- Principle #3: Competence is commensurate with responsibilities.

2.2 SAFETY MANAGEMENT PROGRAM IMPLEMENTATION OF THE GUIDING PRINCIPLES

This interim evaluation was developed using the results of surveillances performed by the Office of EH Residents and other Office of Oversight data sources. The absence of an independent oversight evaluation at ORNL suggests that the information presented should not necessarily be considered representative of overall ES&H performance across ORNL, but rather an indication of the program and/or facility identified. Where sufficient information was not available to make a comprehensive assessment of either the implementation of a Guiding Principle (Section 2.2) or an implementing program (Section 2.3), a limited evaluation or specific examples of performance based on the best available information is provided.

Principle #1 - Line Management Responsibility for Safety

A review of 1995 surveillance reports, the *Department of Energy Chemical Safety Vulnerability Working Group Report, September 1994* and Office of Oversight data sources suggests that there are some problems associated with lines of authority and accountability for performance.

The representation of multiple program office interests on one site creates some management confusion. More specifically, the clear identification of line management responsibilities by each program office is lacking, and management of ORNL is fragmented within ORO. With several different DOE organizations involved in making management decisions, this fragmentation could result in a safety issue not being reported to the appropriate manager, the problem not being corrected, and a loss of valuable lessons learned. No single individual or organization below the ORO manager has total responsibility for the ORNL site. Defined roles and responsibilities, and effective communications are essential.

Corrective action program deficiencies were noted in occurrence reporting and the nuclear criticality program.

Principle #2 - Comprehensive Requirements

Although ORNL has developed comprehensive requirements for most areas, surveillance reports indicate that requirements were not always well understood, implemented, or evaluated. For example, within the nuclear criticality program there were no procedures for conducting nuclear criticality evaluations and corrective action program documentation to demonstrate compliance with conduct of operation requirements was lacking.

Principle #3 - Competence Commensurate with Responsibilities

Not evaluated.

2.3 IMPLEMENTING PROGRAMS

Environmental Protection Program

The following conditions pose potential risks to the environment: aging facilities, uncharacterized areas containing potentially hazardous materials, chemicals stored in facilities not intended for that purpose, facilities placed in caretaker status without appropriate cleanup or documentation, the lack of formality and rigor being applied in managing hazardous materials, and weaknesses in emergency preparedness.

Nuclear Safety Program

The nuclear criticality program was cited in surveillance reports as deficient in several areas:

- The contractor has taken steps to improve the nuclear criticality program at ORNL; however, DOE line management had not conducted programmatic reviews at either the field or site level as of March 1995. ORNL believes it is specifically encouraged to refrain from these type of appraisals in keeping with the ES&H oversight reduction program.

- Although the nuclear criticality safety procedures were upgraded in 1994, criticality evaluations had not been completed for some fissile materials. There has been little if any direct ORO line management oversight of the nuclear criticality program since 1990. The corrective action requirement for a timely renewal program was closed, although the ORNL implementation plan, submitted to DOE Headquarters in September 1995 has yet to be approved. This plan commits to a schedule for conducting evaluations that meet standards, as funding and resources permit. To date, 25 percent of the issued ORNL nuclear criticality safety evaluations meet NCS-3.0 requirements. A new supervisor has been assigned to the NCS section and two new engineers were hired in mid 1995.

Worker Safety and Health Program

EH Resident surveillances observed the following conditions that could put workers at risk:

- At the Molten Salt Reactor Experiment, criticality safety issues forced the evacuation of over 60 personnel from office spaces within the facility.

- Inadequate radiological characterization of the T-30 tank work site contributed to a failure to control work and subsequently resulted in the internal contamination of several workers.

Facility Safety Program

Most of the deficiencies within conduct of operations and occurrence reporting at Oak Ridge are attributable to ORO and Y-12. However, limited and informal DOE oversight of contractor occurrence reporting activities and the absence of oversight of DOE line management occurrence reporting activities may prevent the isolated problems identified at ORNL from being corrected and lessons learned from being shared.

The DOE Chemical Safety Vulnerability Working Group reported in September 1994 that ORNL's chemical safety program was adequate but identified concerns in four areas: (1) uncharacterized areas containing potentially hazardous materials are increasingly accessible; (2) chemicals are stored in facilities not designated for that purpose; (3) facilities were placed in caretaker status without appropriate cleanup or documentation; and (4) inconsistent formality and rigor are applied to managing hazardous materials. As a result:

- Excess and abandoned facilities that may not have been fully evaluated and characterized will become more accessible to workers and the public as operations are shut down. Exposure to hazardous and toxic material environments could occur unless individuals take precautions consistent with the facilities' history

(mission, use, and previous contents). The facilities' history may not be known.

- Facilities moving into caretaker status without thorough cleanup represent a potential hazard and/or environmental concern. Concerns can be aggravated by facility aging and loss of corporate knowledge of the facilities (personnel turnovers, lost documentation, etc.) resulting in chemical hazards when new operations are attempted. There is a potential for fire, employee exposure, inadvertent release to the atmosphere, and higher cleanup costs.

- Inconsistent formality and rigor in managing hazardous materials may result in many materials being stored for long periods, causing further deterioration and increased risks.

- Increased risks may also result from facilities not using the hazardous materials information system for chemical inventories, excluding some hazardous laboratory materials from rigorous controls, and not following handling and housekeeping standards consistent with site procedures and 29 CFR 1910.1450.

3.0 SITEWIDE ES&H ISSUES

3.1 ISSUE DESCRIPTIONS

Sitewide Issue 1: Management of ORNL by ORO is fragmented.

The ORO Reactor Operations Division has management responsibility for several facilities in the Melton Valley area of the site that also contains facilities managed by the Office of Environmental Management (EM). There are also some outside tanks in the HFIR area that are the responsibility of EM. Each of these organizations has its own Facility Representatives; hence, no single individual, or organization, below the ORO manager has total responsibility for the ORNL site. This complex relationship between the DOE organizations creates the potential for inadequate transfer of lessons learned and inconsistency in coverage by Facility Representatives. The above organizations must effectively communicate to achieve consistent and adequate facility safety. Similarly, it is important for EM Facility Representatives to be familiar with and qualified in their respective facility. The need to improve communications was discussed with senior field office managers by the senior resident in a meeting on July 27, 1995.

Sitewide Issue 2: The Molten Salt Reactor Experiment poses potentially serious risks to workers and environment.

At the ORNL site, the Molten Salt Reactor Experiment (MSRE) represents potentially serious risks to workers and the environment due to the potential for chemical reactions, building structural problems, and fuel redistribution.

The MSRE operated as an experimental reactor from 1965 through 1969 under the authority of the Atomic Energy Act of 1954. In 1976, the Energy Research and Development Administration formed the surplus facilities management program, which supported surveillance and maintenance of the MSRE. Currently, DOE Order 5820.2A, specifically Chapter V, addresses the management, surveillance, and maintenance of surplus facilities. All MSRE activities to date have been conducted under the authority of appropriate DOE orders. Several near-term and outyear activities have been planned for the MSRE. These activities are continuation of maintenance actions to improve the safety status of the facility, uranium deposit removal; removal of fuel salts; and facility decontamination and decommissioning.

The maintenance actions conducted in the early phases will continue under the authority of DOE and appropriate health and safety orders. This work phase has been determined to fall under the regulatory authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Time Critical Removal Action Plan. This work

phase requires the generation of an administrative record and an action memorandum explaining the tasks that would be involved and their subsequent impact on the population and the environment. These maintenance actions will include enhancing confinement of the charcoal bed cell, partitioning of the offgas system, and purging and trapping reactive gases from the off-gas system.

The uranium deposit removal phase will be conducted under a CERCLA Non-Time Critical Removal Action, with an EE/CA and public comment period scheduled for mid-1996. The removal of the fuel salts will be conducted under a CERCLA, remedial action. A feasibility study will begin in late 1996 with approvals from Environmental Protection Agency and Tennessee Department of Environment and Conservation (TDEC) expected in late 1997. The final decontamination and decommissioning of the facility after fuel removal will be undertaken as an operable unit within waste area group (WAG) 8, also under CERCLA. The schedule for this final action will depend on completion of the actions described above and its relative priority in relation to other WAG 8 activities. The staff who formerly occupied offices in Buildings 7503 and 75059 at the MSRE were not in any way associated with surveillance and maintenance of the facility. Their access was restricted to office areas, part of the highbay, and adjoining hallways, stairs, and other points of egress. The portions of the facility associated with surveillance and maintenance of the reactor and related systems were locked and controlled by the decontamination and decommissioning staff, and the areas were not accessible to the former occupants. All of the transported radioactive material has been contained within the engineered containment barriers in the facility and has not posed any immediate threat to personnel housed in the facility.

Only limited surveillance systems were in operation continuously at the MSRE facility during its occupancy. When the potential criticality concerns were confirmed, a criticality alarm system was installed and will operate until the special nuclear material has been removed. These systems are augmented by periodic inspections and health physics surveys. These activities are intended to assure early detection of abnormal plant conditions, minimizing the risks to plant personnel.

Transported radioactive material has been contained within the engineered containment barriers in the facility and has not posed any immediate threat to personnel housed in the facility.

The reactor and drain tank cells, are connected by a channel several feet above floor level for the fuel salt transfer line, and are characterized as a single enclosure. Both cells are completely lined with seal-welded stainless steel, which provides a sealed enclosure. Since the reactor was shut down, steam jets in the cell sumps have been deactivated. If water were detected in a cell sump, the system would be reactivated or another appropriate means of water removal would be utilized.

Upon final reactor shutdown and fuel draining in 1969, a leak developed in a freeze valve between one of the drain tanks and the reactor. An estimated 2 to 3 cubic inches of molten fuel salt leaked from the valve into the drain tank cell. As a result, the freeze valves were later removed by remote maintenance and replaced with specially designed pipe plugs. There has not been any other instance of fuel leakage.

Although radiolysis (the radiolytic decomposition of the fuel salt and liberation of fluorine) was known and expected at the time of reactor shutdown, the corresponding oxidation of UF_4 to UF_6 was not known or suspected. Control of generated UF_6 will be achieved through two of the planned interim corrective measures. First, partitioning of the offgas system will preclude migration of the gas from the drain tanks through the offgas piping to other locations. Second, the purge and trap system will remove UF_6 and fluorine

from the system. The next step will be the conversion of UF_6 to a stable oxide and storage in an appropriate facility.

3.2 SITEWIDE ISSUE STATUS

Table 1 characterizes sitewide issues in terms of an issue statement, primary concerns, site activities, and progress evaluation.

4.0 KEY FACILITIES

4.1 FACILITY MISSION

Building 2026 - High Radiation Materials Analytical Laboratory

The facility contains small quantities of fissile material and larger quantities of radioactive materials. Nuclear operations are performed in the hot cells, chemical hoods, and gloveboxes. These activities are primarily analytical chemistry, including the characterization of radioactive material employing such techniques as material dissolution, dilution, separation, and physical measurement. Materials in the facility are highly radioactive, including special nuclear materials in the form of analytical samples, reference materials, and analytical standards.

Building 3010 - Bulk Shielding Reactor

This facility is used to conduct shielding studies. The bulk shielding reactor has been inactive for several years and is awaiting funding for fuel removal and subsequent decontamination and decommissioning. The facility contains spent fuel, and legacy contamination exists in some areas of the facility.

The existing safety basis documentation is for an operating reactor facility and has not been modified to account for current Conditions. The primary facility concern is maintaining and monitoring fuel integrity.

Building 3019A - Radiochemical Development Facility

The major activity within this facility is the safeguarded storage of multikilogram quantities of concentrated fissile nuclides, U-233, Pu-239, and/or U-235. This facility is the national repository for U-233. The facility

Table 1. Sitewide Issues

ISSUE	PRIMARY CONCERNS	SITE ACTIVITIES	PROGRESS EVALUATION
1. Management of the ORNL by the Oak Ridge Operations (ORO) Office is fragmented.	With several different DOE organizations involved in making management decisions, a safety issues may not be reported to the appropriate manager, and lessons learned could be lost. Additionally: ● The transfer to EM of several facilities that still housed highly radioactive material did not appear ready for decontamination and decommissioning. ● EM Facility Representatives are not familiar with, or qualified in, the facilities.	There are presently no plans to correct the organizational deficiencies cited.	Not evaluated **(updated 5/96)**
2. The Molten Salt Reactor Experiment poses a potentially serious risks to workers and the environment.	Spontaneous chemical reaction between fluorine and charcoal (although highly unlikely); reactor and drain tank single enclosure; fuel salt leaks; control of generated UF_6	Development of extensive plans to continue to characterize the facility, implement interim corrective actions, and evaluate alternatives Interim corrective actions include: (1) evaluation of data from pertinent facility parameters and past annealing processes; (2) tests to simulate the radiolysis process with emphasis on understanding the mechanism for uranium hexafluoride generation; (3) completion of interim corrective measures (confinement enhancements for the charcoal bed cell, partitioning of the offgas system, and elimination of secondary water sources); (4) purge and trap of reactive gases (fluorine and UF_6); (5) removal of solid uranium deposits; (6) evaluation of alternatives for removal of fuel from the facility and selection of a preferred alternative; and (7) implementation of the selected fuel removal alternative.	Not evaluated **(updated 5/96)**

is also used for chemical processing and sampling of these materials.

Building 3025E - Irradiated Materials Examination and Testing Facility

This facility supports post irradiation testing efforts of several groups within the metals and ceramics division. Some of the processes include scanning electron microscope fractography, precision densitometry, tensile testing, pressurized tube profilometry, crack arrest and growth studies, fracture toughness studies, uniaxial fatigue testing in air and under vacuum, and transmission electron and field ion microscopy specimen preparation and testing of Charpy impact specimens for the High Flux Isotope Reactor pressure vessel surveillance program.

Building 3027 - Special Nuclear Materials Vault

This building was designed for and is used for storage of special nuclear materials. All special nuclear materials other than fuel elements are stored in Department of Transportation approved shipping containers or other approved containers.

Building 3038 - Isotope Development Laboratory

This facility is currently used for temporary radioactive material storage. Plans are to remove all stored radioactive materials and place the facility into the decontamination and decommissioning program.

Building 3517 - Fission Product Development Laboratory

This facility was originally used to separate kilocurie amounts of fission products including Cs-137 and Sc-90, and to process Ir-192.

The facility was shut down in 1989, but continues to store quantities of fission products and 500 grams of Cm-244. Plans call for the removal of all remaining radioactive isotopes by 1998 and deactivation by 1999.

Building 3525 - Irradiated Fuel Examination Laboratory

This facility is used for receipt, handling, and testing of irradiated materials (fuel or non-fuel, typically as experimental capsules) in shielded casks; transfer of material into and out of the hot cells; capsule disassembly; nondestructive and destructive testing of irradiated materials; packaging and shipment of irradiated materials (onsite or offsite); waste packaging for disposal; maintenance of remote equipment; and decontamination of the facility and equipment.

Examination and testing activities include metrology; metallographic sample preparation by sectioning, grinding, and polishing; optical and electron microscopy; mass spectrometry of fission gases; gamma spectrometry; and other physical properties evaluation of experimental objectives from a particular program.

Building 7503 - Molten Salt Reactor Experiment

The MSRE involves a graphite-moderated, liquid-fueled reactor built to investigate the practicality of the molten salt reactor concept. The reactor was shut down in 1969 and the fuel was removed to storage tanks located in a below grade cell within the reactor complex. Major design inadequacies are now being addressed, associated with the long-term storage of the fuel salt.

The high bay is used as a temporary storage facility for irradiated solid steel test specimens. Activities include maintenance, surveillance, and remediation and characterization of risks associated with fuel migration into portions of the reactor systems not designed to store reactor fuel.

MSRE Facility-Specific Issue 1: MSRE Safety Operations

Safety of operations for the MSRE remediation activities is degraded by inadequacies in the safety basis documentation, inadequate oversight, configuration management and conduct of operations deficiencies, and the level of review of readiness for a startup of new activities.

The technical adequacy of the current MSRE safety basis authorization is questionable for the following three reasons: (1) authorization basis is not contractor approved, (2) technical safety requirements within the Basis for Interim Operation (BIO) have not been implemented properly (e.g., O_2 level exceeding 1 percent without proper corrective actions), (3) the safe operating limit on the O_2 level in the charcoal bay cell as established in the preliminary hazards assessment and BIO has been exceeded on seven different occasions since August 1995, and no effective corrective action was taken to correct the root cause or to screen the deviation from required operating parameters, until questioned by Oversight. The actual cause was failure of management to direct operations personnel to maintain the CO_2 system supply. Further, there are no operating instructions or procedures to cover the requirement; therefore, there are no associated limits or requirements as to when the bottle should be changed or at what level the O_2 should be maintained.

The control of pressure within the drain tanks and flush systems and the offgas system is a facility condition taken credit for in both the BIO and preliminary hazards assessments to reduce the vulnerability of a potential release of UF_6 gas or particulate uranyl fluoride (UO_2F_2) within the facility or to the environment. Technical evidence suggests that many plugs of solid UF_6 may exist within these systems, precluding demonstration of satisfactory pressure control.

Configuration management deficiencies have resulted in some operational and safety related problems associated with MSRE systems. The configuration management program, on which the MSRE BIO depends, must be adequately established for MSRE remedial actions. In two cases, ventilation system components were misidentified on drawings, which were not caught by the initial assessments (part of the configuration management program). Also, a CO_2 regulator was installed in the MSRE CO_2 addition system without a required 0.25-mm diameter orifice, violating a protective condition in the BIO.

DOE safety oversight has been lessened by inadequate staffing and/or limited involvement. For example, DOE staffing for the MSRE project is significantly less than programmed; the project manager and Facility Representative have responsibilities related to other facilities, which compete for their time. There appears to be little involvement from the ORO safety and health division in reviewing MSRE activities for safety considerations; the Facility Representative does not have time to review safety basis information or the policies and procedures used to conduct facility operations; and the DOE project manager was not made aware of the first 6 times the CO_2 system exceeded limits, although each case was clearly documented in facility logs.

Building 7700 - Tower Shield Reactor

This nuclear facility is in standby awaiting funding to remove the reactor fuel and to start decontamination and decommissioning. The reactor was built to perform shielding studies.

The facility contains spent fuel, and legacy contamination exists in some areas of the facility. There is a shutdown plan for this facility; however, the existing safety basis documentation addresses an operating reactor facility and has not been modified to account for current conditions.

Building 7900 - High Flux Isotope Reactor

This reactor is operated for research and the production of radioisotopes for medical and industrial uses. A fuel storage pool in the reactor facility contains a large inventory of spent fuel from past reactor operations. This pool was recently modified to increase its storage capacity.

Building 7920 - Radiochemical Engineering Development

Programmatic activities at this facility include recovery and purification of transuranic elements from irradiated targets for use in research, fabrication of americium/curium targets for irradiation in the high flux isotope reactor, power reactor fuel cycle studies, production of special isotopes for research, alpha glovebox laboratories for development studies, and analytical chemistry for alpha emitters.

Liquid Low-Level Waste System

This facility processes large quantities of liquid waste containing of hazardous and low level radioactive byproducts. Transfer of the end product for disposal is also part of this project.

4.2 FACILITY SUMMARY

Table 2 summarizes key facility characteristics, including status, authorization basis, design basis accident, and hazards.

5.0 PERFORMANCE MEASURES

This section is under development and will be presented in future versions of the site profile.

Table 2. Facility Summary

FACILITY NAME	STATUS	HAZARD CLASSIFICATION/ AUTHORIZATION BASIS	WORST CASE DESIGN BASIS ACCIDENT (1)	PRINCIPAL HAZARDS AND VULNERABILITIES
Building 2026, Radioactive Materials Analytical Laboratory	Operational	Category III nuclear facility; Basis for Interim Operation (BIO): IP/2026/F/7-93/R1 (9/95)	Loss of shielding initiated by window gasket failure; results in exposure of workers to high radiation source	**Hazards:** Highly radioactive and toxic materials. **Vulnerabilities:** Worker exposure to high radiation source or risk for uptake of radioactive or toxic materials.
Building 3010, Bulk Shielding Reactor	Standby, awaiting funding to remove spent nuclear fuel	Category II nuclear facility; Tech Specs: ORNL/TM-6344, 6345; Shut down Plan: ORNL/RRD/INT-84	Bounding accident for shutdown condition not discussed in current authorization basis	**Hazards:** Fissile and highly radioactive material. **Vulnerabilities:** Worker exposure to radiation sources or risk for uptake of radioactive materials.
Building 3019A, Radiochemical Development Facility	Operational	Category II nuclear facility; Basis for Interim Operation: BIO/3019-CTD/SSE/R0 (9/95)	Thorium nitrate spill during solution pumping or uranium powder spill with a concurrent cell breach; both result in airborne radioactivity release to environment	**Hazards:** Highly radioactive stored materials; fissionable materials; acids, bases, other chemicals (industrial hazards). **Vulnerabilities:** Worker exposure to high radiation sources or risk for uptake, or exposure to radioactive contamination.
Building 3025E, Irradiated Materials Examination and Testing Facility	Operational	Category III nuclear facility; Basis for Interim Operation: IP-BIO/3025E-M&C/ SSE/R1 (9/95)	Loss of shielding due to damage to cell window; results in exposure of workers to high radiation sources	**Hazards:** Highly radioactive metallic and ceramic samples with primarily induce Co-60 activity; flammable solvents and cleaners; laboratory chemicals; liquid nitrogen. **Vulnerabilities:** Worker exposure to high radiation sources or risk for uptake of or exposure to radioactive or toxic materials.
Building 3027, Special Nuclear Material (SNM) Vault	Operational	Category II nuclear facility; Basis for Interim Operation: IP/3027/F/7-93/R1 (9/95)	Deliberate compromise of special nuclear material (SNM) container integrity; airborne radioactivity release in facility	**Hazards:** Highly radioactive materials; significant quantities of SNM. **Vulnerabilities:** Workers are at risk for uptake of or exposure to toxic or radioactive material.

Table 2 (cont'd). Facility Summary

FACILITY NAME	STATUS	HAZARD CLASSIFICATION/ AUTHORIZATION BASIS	WORST CASE DESIGN BASIS ACCIDENT	PRINCIPAL HAZARDS AND VULNERABILITIES
Building 3038, Isotope Development Laboratory	Standby, used for shipment and receipt of radioactive sources	Category II nuclear facility; Basis for Interim Operation: BIO/3038-ER-CTD/ SSE/R0 (9/95)	Unmitigated facility fire resulting in the release of airborne radioactivity with resulting high dose at the site boundary	**Hazards:** Highly radioactive and fissile materials. **Vulnerabilities:** Some workers are at risk to exposure to radioactive materials. Large groups of ORNL site personnel and some members of the public would be at risk for uptake of radioactive material from the worst case unmitigated accident scenario.
Building 3517, Fission Product Development Laboratory	Shut down, used to store highly radioactive material	Category II nuclear facility; Basis for Interim Operation: BIO/3517/CTD/ER/R0 (9/95)	Earthquake causes crack in hot cell wall; releases airborne radioactivity to the environment	**Hazards:** Highly radioactive material. **Vulnerabilities:** Some workers are at risk to exposure to radioactive materials. Larger groups of ORNL personnel and some members of the public would be at risk for uptake of radioactive material from the worst case unmitigated accident scenario.
Building 3525, Irradiated Fuel Examination Laboratory	Operational	Category II nuclear facility; Basis for Interim Operation: IP/3525/F/7-93/R1 (9/95)	Unmitigated criticality accident resulting in high radiation source; dropped shielded cask exposing highly radioactive material inside the facility	**Hazards:** Highly radioactive materials, fissionable materials, radiation sources; toxic, corrosive, and reactive materials; flammable materials. **Vulnerabilities:** Workers are at risk of exposure to high radiation sources due to unmitigated worst case accidents. Some workers are at risk for uptake of radioactive or toxic materials.
Building 7503, Molten Salt Reactor Experiment (MSRE)	Shut down, being remediated as a CERCLA project	Category II nuclear facility; Basis for Interim Operation: ORNL/BIO/MSRE/ ERP/R0 (9/95)	Worst case accidents all involve release of large amounts of UF_6 gas; 19 event scenarios having high unmitigated consequences are given	**Hazards:** Highly radioactive materials; fissionable materials; radiation sources; toxic, corrosive, reactive and explosive materials. **Vulnerabilities:** Workers involved in remediation activities are at risk for uptake of radioactive or toxic materials and exposure to high radiation, contamination, or toxic materials, primarily from release of UF_6 gas. Low risk of accidental criticality.

Table 2 (cont'd). Facility Summary

FACILITY NAME	STATUS	HAZARD CLASSIFICATION/ AUTHORIZATION BASIS	WORST CASE DESIGN BASIS ACCIDENT	PRINCIPAL HAZARDS AND VULNERABILITIES
Building 7000, High Flux Isotope Reactor	Operational	Category I nuclear facility; BIO dated September 1995	Large break loss of coolant accident resulting in release of airborne radioactivity to the environment	**Hazards:** Highly radioactive materials. **Vulnerabilities:** Workers are at risk for uptake of and exposure to radioactive material. Large groups of workers outside the facility and some members of the public would be at risk from the release associated with the design basis accident.
Building 7700, Tower Shield Reactor	Standby, awaiting funding to remove spent fuel	Category II nuclear facility; Tech Spec ORNL/TM-4641, Facility Shutdown Plan ORNL/RRD/INT-88	Bounding accident for shutdown condition not discussed in the current authorization basis	**Hazards:** Fissile and highly radioactive material; radiation sources. **Vulnerabilities:** Workers are at risk for uptake of and exposure to radiation and radioactive material.
Building 7920, Radiochemical Engineering Development Center	Operational	Category II nuclear facility;: BIO/7920-CTD/OD/R0 (9/95)	Rapid decomposition of or fire in nitrated radioactive anion exchange resin, resulting in airborne radioactivity release	**Hazards:** Radioactive sources; toxic, corrosive; reactive materials; small quantities of fissionable material. **Vulnerabilities:** Some workers are at risk for uptake of or exposure to highly radioactive and toxic materials.
Building Liquid-Low-Level Waste System	Operational	Category II nuclear facility; Basis for Interim Operation: ORNL/WM-LGWO/ LLLW/BIO/R0 (9/95)	Tank overfill or dropped heavy load with system breach, in evaporator facility; both result in liquid spills with attendant airborne radioactivity release	**Hazards:** Significant quantities of radioactive, hazardous, or mixed wastes. **Vulnerabilities:** Some workers are at risk for uptake of or exposure to radioactive or toxic materials.